Monitoring Arctic Ocean Hydrography
Using Autonomous Underwater Vehicles

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LONG-TERM GOALS

Recent observations in the Arctic Ocean indicate that it is undergoing substantial change on a basin scale. Our project goal is to develop Autonomous Underwater Vehicles (AUVs) capable of observing basin scale evolution in the Arctic. This requires the development of energy, navigation and communication systems specifically tailored for extended autonomous operations under ice. We will provide a means of monitoring changes taking place in the Arctic Ocean and investigate its impact on global warming. Such a capability is of national and global interest and importance.

OBJECTIVES

Our goal is to develop AUVs capable of supporting a suite of oceanographic and mapping sensors, with a range greater than 1000 km and a depth rating of at least 1500 m. Research will also be directed towards the development of communication systems using self locating transponders that are remotely installed in the ice. The vehicle will be demonstrated in a field experiment in summer of 2000. We call that deployment ALTEX for Atlantic Layer Tracking Experiment.

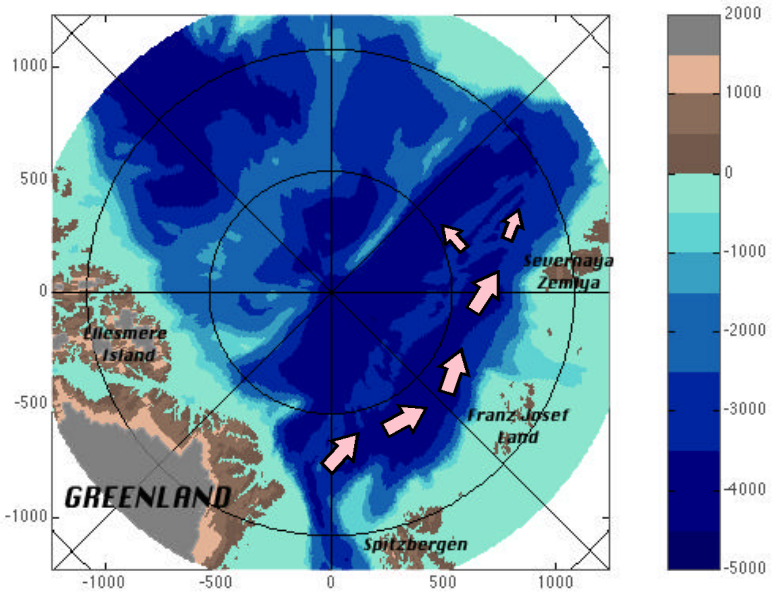

Figure 1: Possible path of the Atlantic water intrusion into the Arctic basin.

APPROACH

A mission has been defined to focus development of the AUV. That mission is to track the Atlantic layer intrusion into Arctic basin. It requires following the 1300 m isobath of Nansen Basin, with occasional excursions of approximately 50 kilometers.

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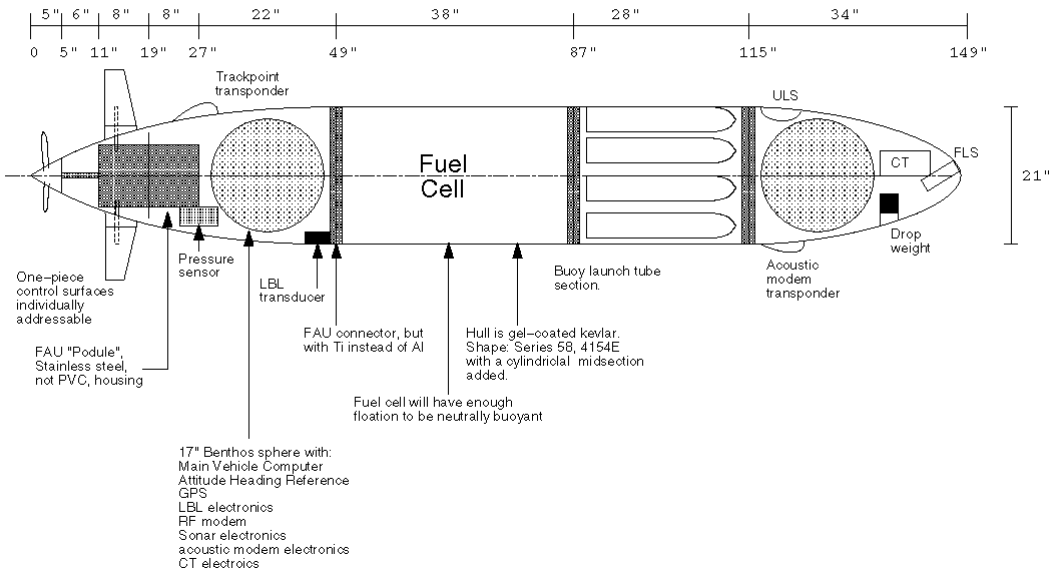
The vehicle will run at a depth of 275 m, but will obtain a full water column profiles on at least a daily basis. For this mission, the vehicle is expendable - data is reported by telemetry buoy. Ice thickness measurements are obtained during the telemetry buoy launch phase.

The four principle challenges are: high latitude navigation, communication from beneath the ice, energy storage, and long-term reliable operation of the AUV. The highly interdisciplinary nature of the project has lead to the formation of a team of investigators and institutions. These are:

Dr. James G. Bellingham	AUVs, Project Lead	MIT Sea Grant
Dr. Dana Yoerger	AUVs	WHOI
Dr. Albert Bradley	AUVs, Navigation	WHOI
Dr. Samuel Smith	AUVs	FAU
John Stannard	Fuel Cells	Fuel Cell Technologies, Ltd.
Dr. Peter J. Stein	Communications	Scientific Solutions, Inc.
Dr. James E. Overland	Arctic Science	Pacific Marine Environmental Laboratory
Mr. W. Kirkwood	Design	Monterey Bay Aquarium Research Institute

A modular AUV with parallel mid-body sections is being developed. The general AUV design approach is to minimize the use of pressure housings, putting as many systems as possible in smaller, lighter oil-filled (pressure compensated) enclosures resulting in a small, deep rated system. To achieve the desired range capability, we will employ a fuel cell energy system constructed by a team composed of Yardney Technical Products and Fuel Cell Technologies, Ltd. The system being developed is unique in that it will be pressure compensated and therefore deep-ocean rated. Communication will be provided by buoys designed to melt through the ice, and telemeter mission data via Argos. The buoys will also be equipped with GPS, so that a position fix can be obtained. Other components of the vehicle will be a mix of systems developed for earlier generations of AUVs by the partner organizations. While some new systems are being developed, the objective to leverage existing technology to the degree possible.

ALTEX reference vehicle mechanical layout



WORK COMPLETED

We are in the design phase of the AUV project.

IMPACT/APPLICATIONS

While the developmental effort is towards a vehicle for the Arctic, this advanced vehicle can be used for other oceanographic applications such as deep sea vent studies, studies of the sea floor spreading, exploration of the Antarctic ice shelf, and coupled observation/modeling systems in coastal and continental shelf environments. Military application sof

RELATED PROJECTS

1) AOSN MURI - Real-Time Oceanography With Autonomous Ocean Sampling Networks: A Center for Excellence

2) Several STTR and SBIR efforts.

REFERENCES

Curtin T., Bellingham, J.G., Catipovic, J., and Webb, D. 1993. Autonomous Ocean Sampling Networks. *Oceanography*, 6(3):86-94.

AUV Laboratory home page:
http://seagrant.mit.edu/~auvlab/

PUBLICATIONS